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Federal Communications Commission
Washington, D.C. 20547

EX PARTE

March 14, 1997

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, D.C. 20554

Re: Written Ex Parte
CC Docket No. 96-262

Dear Mr. Caton:

Attached hereto is an update of the Commission's short-term productivity study prepared by the National Economic Research Associates, Inc. for the United States Telephone Association (USTA). This empirical analysis of productivity updates the calculation relied upon in CC Docket No. 87-313 and in CC Docket No. 94-1 to determine the productivity offset applicable to the local exchange carriers under price cap regulation. As USTA's comments in this proceeding clearly state, USTA continues to support total factor productivity as the appropriate measurement of productivity.

The original and a copy of this empirical analysis is being filed in the Office of the Secretary on March 14, 1997. Please include it in the record of the above-referenced proceeding.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Linda Kent", written in a cursive style.

Linda Kent
Associate General Counsel

Attachment

cc: Jay Atkinson
Anthony Bush
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A handwritten number "24" in black ink, written in a cursive style.

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**AN UPDATE OF THE FCC
SHORT-TERM PRODUCTIVITY STUDY
(1985 - 1995)**

**Prepared By
National Economic Research Associates, Inc.**

**Prepared For
United States Telephone Association**

March 1997

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I. INTRODUCTION

This study has been prepared on behalf of the United States Telephone Association (USTA) and its members to support the industry's evidence in the Access Charge Reform proceeding at the Federal Communications Commission (FCC)¹. In this study, we continue our work of updating the calculation relied upon in CC Docket No 87-313 Second Report and Order to determine the productivity offset (X) applicable to a group of local exchange carriers (LECs).² In light of five years of new data since the Second Report and Order, this study was prepared in anticipation that the FCC might choose to once again rely upon an update of the methodology that it has used in two previous occasions to set the productivity offset.

As in the Commission's original study, we calculate the value of X in the Federal Communications Commission's (FCC's) Balanced 50/50³ price cap formula. The value we calculate would be required to obtain the same growth in interstate access prices that would have been observed through 1995. We generally replicate the method used by J. Christopher Frentrup and Mark I. Uretsky in their report prepared for the FCC, *A Study of Local Exchange Carrier Post-Divestiture Switched Access Productivity*.⁴ Since the FCC relied on the F-U study in its determination of an initial value of the productivity offset and in its update of X in the LEC Price Cap Performance Review in 1995, it seems likely that an update of the F-U study could be used by the FCC to evaluate the parameters of the plan in light of five additional years of experience. In an attempt to replicate the results the Commission would obtain if it updated

¹ In the Matter of Access Charge Reform et. al., CC Docket Nos. 96-262, 94-1, 91-213, 96-263, Notice of Proposed Rulemaking, Third Report and Order, and Notice of Inquiry, released December 24, 1996.

² In the Matter of Policy and Rules Concerning Rates for Dominant Carriers, CC Docket No. 87-313, Second Report and Order, Appendix C. Our most recent update is *Productivity Offsets for Carrier Access Services of Local Exchange Carriers: 1984-1993 An Update of the FCC Short-Term Productivity Study*, National Economic Research Associates, March 1995.

³ The Commission's Balanced 50/50 plan is described in Appendix III. The intent of this balancing was to split 50/50 the financial benefits of growth in Carrier Common Line minutes of use in excess of non-traffic sensitive (NTS) cost growth.

⁴ Appendix C of the Federal Communications Commission Second Report and Order in CC Docket No. 87-313, released October 4, 1990 ("F-U").

its original F-U study, we have excluded the 1984/85 data period, consistent with the Commission's 1995 Order. In addition to a recalculation of the F-U study excluding the 1984/85 data point, the Commission's 1995 Order introduced a staff study which described four technical revisions to the way the X was estimated. That study was not reviewed or commented upon in any public forum and the present study does not include any of the technical revisions it described.⁵

The results of this study indicate that the recalculated LEC unitary productivity offset for interstate switched access services over the 1985/86 through 1995 period is 3.42 percent.⁶ This compares to 3.49 percent from the original F-U study.⁷ In sections following we will briefly review the original F-U study methodology, discuss the calculations and present results from our update of this study. In addition, we include four appendices containing: (i) information on direct and indirect calculations of total factor productivity; (ii) a description of our demand stimulation calculations; (iii) a description of the Commission's Balanced 50/50 plan; and (iv) a presentation of tables of data.

II. ORIGINAL FRENTRUP-URETSKY STUDY

In Appendix C to the Second Report and Order, Frentrup and Uretsky calculate a productivity offset based on data provided independently by the LEC industry and by AT&T, using the basic methodology introduced by Bellcore.⁸ The method used calculates a productivity offset by subtracting the rate of growth of interstate access prices (adjusted for changes in the authorized rate of return and actual earnings, exogenous changes and demand

⁵ *In the Matter of Price Cap Performance Review for Local Exchange Carriers*, CC Docket No. 94-1, First Report and Order, released April 7, 1995, Appendix D.

⁶ The Unitary X concept is presented in paragraph 12 of the F-U study.

⁷ The FCC's original F-U study estimate of 3.49 percent was for the period from 1984/85 through projected 1990/91.

⁸ Bellcore, "The Impact of Federal Price Cap Regulation on Interstate Toll Customers," filed March 17, 1988, and "The Impact of the FCC Proposed Price Cap Plan on Interstate Consumers," filed August 18, 1988, in CC Docket 87-313.

stimulation) from the rate of inflation (as measured by the U.S. national rate of inflation).⁹ The F-U study examined switched access revenue, cost, and demand data from 1984/85 through 1990/91 in order to determine the productivity offset, or “X factor.” This is the X factor that would have been necessary if the Commission’s Balanced 50/50 price cap plan were in effect through 1990/91 to arrive at the same prices as actually occurred under rate of return regulation during that period.

To account for exogenous changes that took place, revenues in each period were adjusted to the level that would have occurred had the exogenous events not taken place. Similarly, because some exogenous events affect demand, (e.g. the direct assignment of WATS) demand was recast to the level that would have occurred absent the exogenous event. Demand stimulation due to the introduction and increase in the Subscriber Line Charge (SLC) was also taken into account when calculating revenues per minute.

Based on the fact that the benchmark rate of return was represcribed during the study period, revenue was also adjusted to equate the realized return on investment with a constant authorized benchmark rate of return. Economic theory postulates that in the long run, competition erodes economic profits to the point where total revenues are equal to total economic costs. Adjusting revenues to a constant benchmark rate of return, as explained in more detail in Appendix I, attempts to eliminate changes in economic profits and allows the view expressed in the original F-U study that revenue per minute equals cost per unit of output in every time period.

Revenues per minute adjusted for the aforementioned factors were then used to calculate a trend line regression to estimate the beginning and ending CL, TS and total switched estimated revenues divided by estimated minutes. The Commission’s formulas for calculating allowed price changes, including the balanced 50/50 plan, were then applied five times to rates

⁹ Access prices (revenue per minute) adjusted for exogenous changes, rate of return and demand stimulation equate to a measure of cost per minute of output.

from 1984/85 to 1990/91. The original Frentrup-Uretsky study estimated that the appropriate productivity offset was 3.49 percent.

III. NERA UPDATE

The purpose of the F-U study was to calculate the X factor that, had the Commission's proposed price cap plan been in effect during the entire post-divestiture period, would have produced the same prices in 1990/91 as actually occurred under the then prevailing rate of return regulation in that period. In this study, however, five additional observations are taken from years in which most of the LEC industry was under federal price cap regulation. As will be discussed in more detail in Section III. C. below, in order to preserve the incentive benefits of price cap regulation, we view the X calculated herein as a ceiling—the value of X above which incentives otherwise embodied in price regulation are diminished.

A. Data

Following the Commission's original F-U study and the 1995 Order, we examine ten post-divestiture periods: June 1985 through May 1986 (1985/86), July 1986 through June 1987 (1986/87), calendar year 1988 (1988), annualized year 1989 (1989), calendar year 1990 (1990), calendar year 1991 (1991), calendar year 1992 (1992), calendar year 1993 (1993), calendar year 1994 (1994) and calendar year 1995 (1995).¹⁰ Data are examined for all Tier-1 LECs, Tier-2 LECs that are part of Tier-1 companies, and NECA companies. The last five periods in our analysis are price cap periods during which over 90 percent of LEC interstate revenue was regulated under federal price cap regulation and price cap LECs had a choice between lower offsets with sharing and higher offsets with different sharing provisions or, beginning in 1995, no sharing. The data used in this report, as well as the results, are reported in Appendix IV.

¹⁰ In the F-U study, six post-divestiture periods were available. The Commission's original study began with data from 1984/85 and the sixth period used forecast data for the 12-month period July 1990 through June 1991. In the present study, we exclude 1984/85 data and use calendar year 1990 data.

B. Method

This study uses the same technique to calculate the post-divestiture pre-price cap productivity offset as was used in the original F-U study. The current study examines switched access revenue, cost, and demand data that result in the 1995 prices obtained under the Commission's Balanced 50/50 price cap plan. As in the previous studies, there are two interpretations to our calculation. First—and most direct—we calculate the X value required in a hypothetical Balanced 50/50 price cap plan that would just reproduce the growth in prices over the period if regulation had kept accounting earnings constant. Alternatively, this study estimates the LEC productivity differential—the difference between LEC total factor productivity growth (for interstate switched access services) and the U.S. total factor productivity growth embodied in the rate of growth of GDP-PI.

One can treat the historical data as having been generated by ten price cap annual filings: initial rates are the 1985/86 rates and each subsequent rate period in the data is produced by an update filing.¹¹ We thus determine the value of the X which, in principle, would produce the rate in the final (1995) period. A description of the mechanics of our analysis are as follows.

1. Analysis Steps

This study, like the F-U study, is based on realized average revenue per minute instead of tariffed rates. Revenues are adjusted for earnings, exogenous cost changes and cost shifts from subscriber line charges. Minutes are adjusted for the demand stimulation associated with cost and revenue changes. Following the original F-U study methodology, we use the current period as the base for our revenue adjustments. Revenue is adjusted as follows.

1. The base period of the study is 1995; hence total revenues in each access period are restated to reflect the authorized rate of return for rate of return regulated LECs of 11.25 percent;

¹¹ As in the original F-U study, "rates" are assumed to be assumed to be equivalent to the measure of cost per unit of output.

2. Common line revenue is adjusted for inside wire (IW) and customer premise equipment (CPE) and traffic sensitive revenue is adjusted for equal access (EA); and
3. To account for exogenous cost changes, revenues in each period prior to 1995 are also adjusted to the level that would have occurred if the exogenous cost changes prior to that period had not taken place.

Since the specific changes to the revenue requirement described above are not associated with increased productivity growth, the F-U method isolates and removes the effect of these price changes on demand from the calculation. Following the original F-U study methodology, we also adjust demand. Again, following the original F-U study methodology, we use the first access period as the base period for our adjustments to minutes. Minutes are adjusted to remove the demand changes associated with:

1. The adjustment of revenues to a constant benchmark accounting rate of return;
2. The adjustment of common line revenues to account for IW and CPE;
3. The adjustment of revenues due to SLC;
4. The adjustment of traffic sensitive revenues to account for EA; and
5. The adjustment of revenues due to exogenous cost changes.¹²

Adjusted revenue and adjusted minutes are used to determine adjusted revenue per minute (price) for each of the ten access periods.¹³ Both common line and traffic sensitive prices are then used to fit a trend line regression. The regression parameters are used to calculate the fitted values of the beginning and end point prices used in the repetitive application of the Commission's price cap formula. Thus, in principle, we begin with the actual rates for common line and switched access. For any given value of the productivity offset X,

¹² In addition to the cost-affecting exogenous changes accounted for in the adjustments to revenue described above, when adjusting demand we also account for revenue-affecting exogenous changes reported by the LEC industry and approved by the FCC.

¹³ As in the F-U study, this measure of price is equivalent to a measure of cost per unit of output.

we use the average actual changes in GNP-PI¹⁴ and CL minutes of use per line growth and adjust each period's rates using the FCC's Balanced 50/50 formula to determine the next period's rates. We conduct the process a total of nine times until 1995 rates are obtained. The result is a value of X which, if applied in each of the ten hypothetical price cap update filings, would just produce the fitted value of adjusted switched access rates in 1995.

2. Exogenous Change Adjustments

The purpose of adjusting for exogenous changes is to eliminate those factors that affect average revenue per minute—and thus the F-U study's measure of productivity over time—which are external to the LEC. Given the assumption that revenues equal costs, by adjusting revenues for these external factors we isolate revenue per minute changes which are internal to the firm and which the firm is able to influence.

The exogenous changes that were used in the FCC's F-U study were: (1) the transition of the subscriber plan factor (SPF) to 25 percent; (2) the revised separations treatment of local commercial operations expense (Account 645); (3) the direct assignment of closed-end WATS lines to the special access category; (4) the implementation of reserve deficiency amortization to compensate for inadequate depreciation levels; (5) the effects of the 1986 Tax Reform Act; (6) the revised separations calculation of the dial equipment minutes (DEM) factor; (7) the revised separations treatment of central office equipment category 4 terminations; (8) the revised separations treatment of revenue accounting expenses (Account 662); (9) the adoption of a new Uniform System of Accounts (Part 32) in place of Part 31, including conformance of Parts 36 and 69 of the Rules to Part 32; and (10) the revised (accounting) treatment of pension expenses.¹⁵

¹⁴ Up to 1994 we used GNP-PI, after which we used GDP-PI.

¹⁵ In addition to these exogenous categories, this study includes other exogenous categories which the industry has included (with FCC approval) in the five most recent annual price cap filings. These include (1) NECA long term and transitional support; (2) inside wire amortization; (3) excess deferred taxes; (4) investment tax credit; (5) sharing; (6) telephone relay service; (7) other post employment benefits (OPEB); (8) general support facilities; (9) regulatory fees, and (10) other.

Following the original F-U study methodology, revenues are adjusted using the final year as the base. Since in this study the final year is 1995, exogenous cost changes are accumulated relative to 1995. Thus the exogenous change adjustment for 1994 is the sum of the exogenous cost changes in 1995, and the adjustment for an earlier year (e.g., 1988) is the sum of the adjustments from 1995 through 1989. By this process, revenue in each year is adjusted to the level that it would have been if 1995 rules had been in effect.

3. Other Revenue Adjustments

In reproducing the basic methodology employed in the F-U study, a number of additional adjustments to revenue are made. CL and TS revenue are recast to earn 11.25 percent, the currently authorized rate of return for ROR LECs. As explained above and in more detail in Appendix I, this constrains economic profits—using the FCC’s accounting rules and definitions—to zero and thus sets revenues equal to interstate accounting costs. The revenue requirements for inside wire (IW) and customer premise equipment (CPE) are removed. Since IW and CPE were detariffed and excluded from revenue requirements, without this adjustment revenues would be lower, all else equal, and the study methodology would incorrectly attribute this to increased productivity. Finally, Equal Access conversion and Universal Service Fund (high cost fund) costs are also removed. Changes to NTS revenue requirements are adjusted to account for the removal of IW and CPE, evaluated at earnings of 11.25 percent.

4. Demand Stimulation

CL and TS rates in this update, like the original F-U study, are computed as adjusted revenue per adjusted minute of use. Each revenue adjustment (e.g., for exogenous cost changes, changes in the subscriber line charge or inside wire revenue requirement) altered the actual rate charged during the period and thus brought about a demand stimulation effect.¹⁶ Measuring stimulation from a 1985/86 base, the fact that carrier common line revenue

¹⁶ Since demand curves generally slope downward, price reductions lead to quantity increases.

requirements were generally adjusted downward by exogenous events through 1995 means that demand was higher than it would have been if these events had not occurred. These decreases in revenue requirements are assumed by the study method not to be associated with increased productivity growth. Thus, in order to estimate the LEC productivity differential from observed price changes during the period, we must remove their effect from the calculation. For NTS costs, that adjustment would not be enough, however, because the stimulation stemming from the exogenous cost reductions during the period would increase demand in later periods, thus overstating the reduction in adjusted revenue requirement per minute for the purpose of calculating X. If revenues are adjusted to nullify the effect of exogenous changes, then demand must similarly be adjusted. Otherwise, the reduction in revenue per minute caused by stimulation from exogenous cost changes would cause us to overestimate the rate at which LEC CL prices (per minute) were falling during the period.

Demand stimulation in this update, as in the FCC's original F-U study, is calculated relative to a first analysis period base. From a 1985/86 perspective, observed demand in later years was (in net) stimulated by the effects of subscriber line charges and exogenous cost changes, both of which lowered interstate carrier access revenue requirements, carrier access prices, and carrier long distance prices. Had these exogenous events not occurred, demand would have been lower in years after 1985/86 than was actually observed. Hence the effect of accounting for stimulation in this update is to reduce demand in subsequent years. It was a 1984-based stimulation that NERA calculated for filings in CC Docket No. 87-313 and that the FCC adopted and used in its original and updated F-U studies. The details of our demand stimulation calculations are fully explained in Appendix II.

C. Price Cap Data Results In A Ceiling

In contrast to the original F-U study and the FCC's update in 1995, this update contains five periods of data during which certain LECs operated under federal price cap regulation. Under price regulation, firms have the incentive to risk seeking additional returns because under the implicit price regulation contract the firm is allowed to enjoy the rewards of its

success (or suffer the consequences of its failures). Thus, while we applied the same methodological approach as F-U, there is an important conceptual difference. The FCC's methodology requires that revenues be adjusted, in both the rate-of-return and price cap periods, to a constant benchmark authorized rate of return. This is an important adjustment which, along with the accompanying assumption that the existing regulation correctly acts in place of competitive market forces, allows the view that revenue per minute measures cost per unit of output. Under rate of return regulation, where fewer efficiency-improvement incentives exist, revenues in excess of authorized returns could be eliminated and used to calculate X with minimal incentive-reducing effects. Under price regulation, this is not so.

Under price regulation, revenues in excess of a constant benchmark rate of return are likely to be the result of additional effort on the part of the LEC to take advantage of improved incentives. We expect that increased incentives for productive efficiency under price caps translate into tangible cost-reducing and/or revenue-increasing effects. The assumptions underlying the FCC's F-U methodology—identifying and subtracting 'excess' revenues based on a constant benchmark rate of return—result in lower rates of growth in costs over time and thus higher measures of productivity. Given the FCC's F-U methodology, the actual efficiency-enhancing activities that were undertaken by the LECs during the price cap period would become part of the updated X's that are calculated. If such an X became the new productivity target in a forward-looking price regulation plan, then all of the efficiency gains made by LECs (responding to incentives in the current price regulation plan) would accrue to consumers—none would be retained for LEC shareholders. Such an outcome would be a violation of the implicit price regulation contract. It would result in consumers receiving all the benefits while the LECs would be penalized *ex-post* for being productive. For this reason, the X calculated from the F-U method using data obtained from price cap LECs must be viewed as a ceiling.

The above discussion assumes, of course, that the FCC's approach to measuring interstate accounting earnings is appropriate and economically meaningful. As mentioned in some of our earlier filings, however, there can be significant problems in calculating interstate

earnings from accounting rates of return.¹⁷ For example, because regulatory depreciation rates differ from economic depreciation rates, book value of a plant usually does not equal the economic value and imparts substantial bias into measures of the capital stock. Thus, such measures based on accounting—not economic—data can be unreliable. In addition, using such measures assumes that other aspects of the price cap plan—such as exogenous cost changes—are accounted for properly.

¹⁷ W. E. Taylor, T. J. Tardiff, and C. J. Zarkadas, "Economic Evaluation of Selected Issues from the Fourth Further Notice of Proposed Rulemaking in the LEC Price Cap Performance Review: Reply Comments," Attachment B to USTA Reply Comments, CC Docket No. 94-1, March 1, 1996; see also F. Fisher and J. McGowan, "On the Misuse of Accounting Rates of Return to Infer Monopoly Profits," *American Economic Review* 73(1) at 82-97.

IV. RESULTS

We used the F-U study methodology to update previous estimates of X through 1995.¹⁸ We calculate individual CL (using the Balanced 50/50 formula), TS and the Commission's unitary X. In an attempt to replicate the results the Commission would obtain if it updated its original F-U study, consistent with the 1995 Order, we have excluded the 1984/85 data period. The results of this study are presented in Table 1 of Appendix IV. The unitary X for the 1985/86 through 1995 time period is 3.42 percent. This compares to the 3.49 percent estimate from the original F-U study. In the Second Report and Order the Commission established the price cap plan's productivity target of 3.3 percent by (i) averaging the short-term F-U result (3.49 percent) and Spavins¹⁹ long-term result (2.1 percent), and (ii) adding a 0.5 percent consumer productivity dividend.²⁰ Performing the same operation based on our 3.42 percent unitary X, we obtain a productivity target of 3.26 percent.

¹⁸ The F-U method does not and cannot overcome the shortcomings associated with relying on an accounting measure of interstate returns.

¹⁹ *In the Matter of Policy and Rules Concerning Rates for Dominant Carriers*, CC Docket No. 87-313, Second Report and Order, Appendix D.

²⁰ *Ibid*, paragraph 5.

APPENDIX I

to

**AN UPDATE OF THE FCC SHORT-TERM PRODUCTIVITY
STUDY**

(1985-1995)

Analysis and Results Based on Data Received as of 2/22/97

V. APPENDIX I - ALTERNATIVE PRODUCTIVITY MEASURES

A. Total Factor Productivity

Total Factor Productivity is the observed ratio of an index of the physical quantity of outputs to an index of the physical quantity of inputs, and it can be measured by the ratio of an output quantity index to an input quantity index for a given year. Productivity change is the annual change in that ratio.

B. Indirect Productivity

Indirect TFP studies, on the other hand, base an estimate of TFP change on the rate of change of output prices. By definition, the rate of change in output prices for a firm or an industry is equal to the change in its input prices (including exogenous changes in costs) less the change in its total factor productivity:

$$(1) \quad T_o = [T_i + T_z] - TTFP$$

where:

T_o represents the annual percentage change in telecommunications industry (or firm) output prices,

T_i represents the annual percentage change in its input prices,

$TTFP$ represents the annual percentage change in its total factor productivity (the ratio of an index of physical quantities of outputs to an index of physical quantities of inputs), and

T_z represents changes in costs due to external circumstances (e.g., tax rate changes) expressed as a percentage of total cost.

Equation (1) is derived by differentiating the accounting identity that profits equal revenue less costs; the only assumption necessary to derive this relationship is thus that the change in industry profits is zero over time.

There is no convenient measure of the telecommunications industry's change in input prices, so some further simplification is necessary if we are to be able to apply the formula. Since telecommunications firms purchase labor, raw materials, and capital in national markets, it is reasonable to assume that the change in telecommunications input prices is similar to the change in input prices throughout the economy.¹ Assuming further that there are no changes in

¹ See William E. Taylor, Timothy J. Tardiff and Charles J. Zarkadas, "Economic Evaluation of Selected Issues from the Fourth Further Notice of Proposed Rulemaking in the LEC Price Cap Performance Review: Reply Comments" USTA Reply Comments, Attachment B in Docket No. 94-1, January 11, 1996; and Dr. Laurits (continued...)

excess profits in the economy as a whole, equation (1) can be derived for the nation as a whole in the same manner as it was derived above:

$$(2) \quad N_o = [N_I + N_Z] - NTFP$$

Where N_o is the annual change in a national index of output prices, N_I is the annual change in a national index of input prices, $NTFP$ is the annual change in the economy-wide total factor productivity, and N_Z represents exogenous cost changes expressed as a fraction of total costs. Since $N_I = T_I$ by assumption, substituting equation (2) into equation (1) we see that:

$$(3) \quad T_o = N_o - [TTFP - NTFP] + [T_Z - N_Z]$$

Equation (3) indicates that the change in the average output price for an industry or a firm is equal to (i) the change in a national index of output prices less (ii) the difference between the change in total factor productivity for the industry or firm and for the nation as a whole, plus (iii) the difference between the effect of exogenous cost changes in the industry or firm and the nation as a whole. This equation also defines the appropriate annual adjustment for a price cap index: output prices are constrained to grow no faster than an index of national output prices, less adjustments for differential changes in TFP and differential exogenous cost changes.

(...continued)

Christensen in Appendix F of AT&T Comments in response to the FCC's Notice of Proposed Rulemaking in CC Docket 87-313, filed October 19, 1987.

APPENDIX II

to

AN UPDATE OF THE FCC SHORT-TERM PRODUCTIVITY STUDY

(1985-1995)

Analysis and Results Based on Data Received as of 2/22/97

VI. APPENDIX II - DEMAND STIMULATION

A. Non-Traffic Sensitive

Let SLC denote the revenue collected by the local exchange carriers (LECs) from end users through the Subscriber Line Charge. Similarly, let EXOG be the total effect on annual revenue requirements of exogenous changes in costs. R_0 is the baseline (observed) LEC revenue derived from interexchange carrier switched access charges (both carrier common line and TS). To calculate stimulation due to subscriber line charges and exogenous cost changes, let R_1 be the hypothetical LEC switched access revenue from interexchange carriers if there were:

1. no subscriber line charges paid by end users and the revenue shortfall were collected from interexchange carriers through higher switched access charges, and
2. no changes in revenue requirements due to exogenous events.

Thus R_1 exceeds R_0 by the amount of revenue collected from the SLCs and the exogenous cost changes:

$$R_0 = \text{Base Carrier Access Revenue} = [CL Rev + TS Rev] - SLC$$

and

$$R_1 = R_0 + SLC + EXOG .$$

We wish to calculate the reduction in demand that would be caused by a hypothetical increase in switched access prices charged to interexchange carriers to replace the actual SLC revenue received from end users and the revenue requirement removed by the exogenous cost changes. The negatives of these reductions in demand are our estimates of the stimulation in interstate switched access usage due to the implementation of SLCs and the exogenous changes in cost.

For simplicity, we assume the demand function for LEC interstate switched access usage has a constant elasticity given by β , so that

$$q_i = A p_i^\beta \quad (i = 1, 0) ,$$

and

$$R_i = p_i q_i = p_i \times A p_i^\beta = A p_i^{\beta+1} .$$

It then follows that:

$$\frac{R_1}{R_0} = \left(\frac{p_1}{p_0} \right)^{\beta+1},$$

so that

$$\frac{p_1}{p_0} = \left(\frac{R_1}{R_0} \right)^{\frac{1}{\beta+1}}.$$

Thus the price change required to obtain a 10 percent revenue change differs from 10 percent. Rather than using a percentage price change calculated in this manner to calculate demand response, we can directly solve for the quantity q_1 which would result from imposing a price increase of the magnitude necessary to increase revenues from R_0 to R_1 :

$$\frac{q_1}{q_0} = \left(\frac{p_1}{p_0} \right)^{\beta} = \left(\frac{R_1}{R_0} \right)^{\frac{\beta}{\beta+1}},$$

so that

$$q_1 = \left(\frac{R_1}{R_0} \right)^{\frac{\beta}{\beta+1}} \times q_0.$$

The increase in carrier access revenue due to the hypothetical increase in switched access prices caused by (i) the recovery of SLC revenue from interexchange carriers or (ii) the repeal of the exogenous cost changes thus causes an interstate usage reduction from q_0 to q_1 . We will take the difference $q_0 - q_1$ as our measure of interstate switched access demand stimulation caused by the implementation of SLCs or exogenous cost changes.¹

B. Traffic Sensitive

This method is applied to calculate demand stimulation for CL and TS minutes of use. Demand stimulation from SLCs and exogenous cost changes artificially increases measured productivity growth related to NTS costs, since increases in usage do not (by definition) affect costs. Hence the above calculation applies directly to NTS costs and is used to calculate demand stimulation for CL minutes of use.

Demand stimulation from SLCs and exogenous costs is largely irrelevant for TS costs since, to a first approximation, increases in TS demand increase interstate TS costs

¹ Note that this development differs from the method used to calculate stimulation in previous USTA filings in several respects. First, it does not assume that the required percentage change in access revenue will result in an equal percentage change in interexchange carrier access prices. Second, it adopts a constant elasticity demand function. Finally, it calculates demand changes directly from the demand model, rather than multiplying the price elasticity by a percentage change in price, eliminating ambiguity from arc elasticities of demand.

proportionally. Unfortunately, one component of costs in the TS category are actually NTS: the costs associated with line termination at the switch. In the prior NERA (and F-U) studies, this fact was reflected in estimates of the TS stimulated minutes of use. Differing from the CL stimulated usage, TS stimulation was calculated by multiplying the CL demand stimulation percentages by the product of:

1. the base switched TS minutes of use in each period, and
2. the ratio of NTS line termination revenue requirements to total TS revenue requirements.

Thus stimulation proportional to the line termination component of TS revenue requirements was used to adjust observed TS minutes of use. In the current study, the same type of adjustment is made to TS adjusted revenues. The fact that revenue requirements increase less than proportionally with TS demand is accounted for by increasing TS revenue by the product of proportional demand stimulation and the parameter in (ii). Prior to 1988, the parameter in (ii) was taken to be 0.2174, based on line termination revenue requirements of \$1,314.1 million and total switched TS revenue of \$6,043.3 million in the 1985-86 period. For 1988, 1989, and 1990, nine-tenths, seven-tenths, and five-tenths of the line termination revenue requirement was allocated to interstate on a basis independent of current minutes of interstate use, respectively. Hence the ratio of NTS line termination revenue requirements to total TS revenue requirements was taken to be 0.1957 ($= .9 \times 0.2174$) in 1988, 0.1522 ($= .7 \times 0.2174$) in 1989, 0.1087 ($= .5 \times 0.2174$) in 1990, 0.0652 ($= .3 \times 0.2174$) in 1991, and 0.0217 ($= .1 \times 0.2174$) in 1992. If k_t denotes that ratio, s_t denotes the percentage demand stimulation, and $TSREV_t$ denotes TS revenue adjusted for exogenous cost changes, then TS revenue adjusted for stimulation is given by:

$$TSREV_t \times [1 + s_t(1 - k_t)]$$

C. Demand Elasticities

Since R_1 , R_0 , and q_0 are observable for all eleven of the access periods in the current data set, all that is necessary to calculate demand stimulation is the price elasticity of demand for switched access service. Recall that approximately forty-five percent of AT&T's switched service costs are related to switched access.² This fact, coupled with the requirement that AT&T pass access charge changes through to its price cap index, suggests that only forty-five percent of the access price effect will flow through to the toll end user. Therefore, the price elasticity used in the above calculations will be 45% of the -0.723 switched service own price elasticity reported by AT&T.

² This fraction, 0.45 is taken from the AT&T Tariff Filing Reference Package, 1986 Annual FDC Report, Schedule 1 (June 1987), as cited on page 18 of the August 18, 1988 Bellcore Study.

Let p_t and p_a be the price of toll paid by end users and the price of access paid by interexchange carriers respectively. Because changes in access prices are fully passed through to customers as changes in toll prices,

$$\frac{\partial p_t}{\partial p_a} = 1 .$$

By definition, the price elasticity of demand for interstate switched service is given by

$$\beta^* = \frac{\partial Q}{\partial p_t} \frac{p_t}{Q} = -0.723.$$

Similarly, the price elasticity of demand for switched access is

$$\beta = \left(\frac{\partial Q}{\partial p_t} \frac{\partial p_t}{\partial p_a} \right) \frac{p_a}{Q} ,$$

and by multiplying and dividing by P_t , we obtain

$$\begin{aligned} \beta &= \left(\frac{\partial Q}{\partial p_t} \frac{p_t}{Q} \right) \left(\frac{\partial p_t}{\partial p_a} \right) \left(\frac{p_a}{p_t} \right) \\ &= \beta^* \times 1 \times 0.45 = -0.723 \times 1 \times 0.45 \\ &= -0.3254 \end{aligned}$$

Thus to calculate demand stimulation due to a hypothetical change in switched access revenue from R_0 to R_1 , we use equation (1) with a value of β equal to -0.3254.

Table 1
Minutes Data

| Year | Minutes | |
|---------|-------------|-------------------|
| | Common Line | Traffic Sensitive |
| (a) | (b) | (c) |
| 1985-86 | 199,946,832 | 199,487,105 |
| 1986-87 | 198,878,262 | 226,888,173 |
| 1988 | 244,467,327 | 266,721,218 |
| 1989 | 279,513,375 | 295,439,187 |
| 1990 | 305,839,946 | 313,182,502 |
| 1991 | 326,675,691 | 330,060,199 |
| 1992 | 349,305,191 | 349,150,487 |
| 1993 | 371,054,779 | 370,272,375 |
| 1994 | 399,206,744 | 395,731,828 |
| 1995 | 428,506,679 | 421,436,047 |

Notes:

- 1) All minutes figures are shown in thousands of minutes.
- 2) Common line and traffic sensitive minutes provided by the USTA.

Table 2
Revenue Data

| Year | Total Revenue ² | SLC Revenue ³ | Cumulative Exogenous Changes ⁴ | ROR Changes ⁵ | CPE/IW Revenue Requirement Changes ⁶ | EA Changes ⁷ |
|---------|----------------------------|--------------------------|---|--------------------------|---|-------------------------|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| 1985-86 | \$17,440,568 | \$2,484,658 | (\$225,290) | \$0 | \$0 | \$0 |
| 1986-87 | \$17,316,191 | \$3,646,949 | (\$666,106) | (\$191,916) | (\$1,209,828) | \$134,187 |
| 1988 | \$18,244,339 | \$4,563,679 | (\$1,435,596) | (\$343,170) | (\$1,194,144) | \$168,365 |
| 1989 | \$18,444,260 | \$5,703,289 | (\$1,546,158) | (\$352,194) | (\$1,336,698) | \$151,894 |
| 1990 | \$18,061,563 | \$5,926,881 | (\$1,725,363) | (\$348,147) | (\$1,623,656) | \$180,952 |
| 1991 | \$18,005,006 | \$6,062,676 | (\$2,275,759) | (\$712,608) | (\$2,114,251) | \$163,413 |
| 1992 | \$18,535,513 | \$6,230,468 | (\$2,623,822) | (\$705,466) | (\$2,302,036) | \$233,640 |
| 1993 | \$19,545,074 | \$6,491,729 | (\$2,342,223) | (\$717,861) | (\$2,510,045) | \$32,561 |
| 1994 | \$20,350,900 | \$6,964,408 | (\$2,209,305) | (\$719,770) | (\$2,522,178) | (\$51,996) |
| 1995 | \$20,771,260 | \$7,266,852 | (\$2,369,522) | (\$747,363) | (\$2,536,787) | (\$55,787) |

Notes:

- 1) All dollar figures are shown in thousands of dollars.
- 2) Total Revenue is the sum of common line and traffic sensitive revenue.
- 3) SLC Revenue is from data provided by the USTA.
- 4) Cumulative Exogenous Changes are the exogenous changes for both traffic sensitive and common line cumulated forward to 1995, and making adjustments for CPE/IW and Equal Access.
- 5) ROR Changes are the rate of return changes for both common line and traffic sensitive, adjusting them to the 1984 return of 12.75%.
- 6) CPE/IW changes are the difference between the CPE/IW revenue requirement change in that period and the CPE/IW revenue requirement change for the initial period.
- 7) EA changes are the difference between the EA revenue requirement change in that period and the EA revenue requirement for the initial period.